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[001] APPARATUS FOR OPERATING GATES AND THE LIKE

[002] The present invention relates to an apparatus for operating gates defined in more detail in the preamble of claim 1.

[003]

[004] Such operative apparatuses are primarily used in places without the use of electricity, e.g. used to open and close gates in fences, designed to protect wild animals and fences designed to mark off pasture land. These apparatuses are designed to, when a vehicle arrives to the immediate surroundings of a gate, on either side of the gate, automatically open the gate and after a certain time, when the vehicle has passed the gate opening, close the gate again.

[005] Examples of already made proposals for such operative apparatuses are mentioned in GB-A-2 322 669, US-A-4 115 954 and AU-A1-65 309/80.

[006] These known solutions have various drawbacks and consequently they have never had any impact on the market. None of these publications meets a substantial number of various requirements in combination, which is a prerequisite for a general applicability, since it is hardly defensible, to a larger extent than what is very exceptional, to have to repair, serve and replace such devices, which thus in combination must meet the following requirements:

[007] Very far reaching but not completely maintenance-free; independent of the use of electricity, solar cells, engines, fuels, compressed air units etc; functioning in practically all climatic conditions, e.g. from -30°C to $+60^{\circ}\text{C}$; absolutely reliable and having a very large life; an opening and a closing of the gate without requiring, that a person in the approaching and passing respectively vehicle must leave it; selective actuatability solely by vehicles, particularly cars and not by e.g. human beings, wild animals or cattle; faultless functioning in the case of e.g. small private cars and heavy trucks; without complicated and expensive special means easily adjustable opening, opening keeping and closing times; smooth closing processes; noiselessness; possibility of module construction for a simple production and mounting; mounting possibility on existing constructions, e.g. stakes, and using existing stakes.

[008]

[009] The object of the present invention, particularly in the above-mentioned respect, is to in combination improve and develop the state of the art in this technical field.

[010] This object is attained according to the present invention by designing an apparatus for operating gates and the like, according to the introduction, mainly as set forth in the characterizing clause of claim 1. Additional characterizing features and advantages of the invention are mentioned in the following description, reference being made to the enclosed drawings, which in a schematic and only non-limiting, exemplifying way show a preferred embodiment of the invention. The drawings show in detail in :

[011]

[012] Fig 1 a lateral view of a pressure generating unit in an apparatus for operating gates and the like according to the invention, which unit is actuated by an approaching private car;

[013] Fig 2 a lateral view of a pivoting mechanism in the apparatus according to the invention;

[014] Fig 3 the mechanism according to Fig 2, seen from above;

[015] Fig 4 a schematic diagram for a hydraulic circuit in the apparatus according to the invention;

[016] Fig 5 a perspective view from above of a preferred embodiment of an apparatus for operating gates and the like according to the invention;

[017] Fig 6 a perspective view of a detail shown in Fig 5; and

[018] Fig 7 an alternative schematic diagram, similar to the one shown in Fig 4.

[019]

[020] It is principally feasible to design an apparatus according to the invention in such a way, that the gate, which also can comprise two halves, always will be opened horizontally away from an approaching vehicle, regardless of from which side it arrives, but in this specification only the more practical case is described of a gate, which can be moved against a stop in or beside the gate opening and consequently always is opened and closed in the same direction, e.g. with the opening movement towards an enclosed area. If wild animals or cattle are pressing against the gate, then the stop will prevent it from being opened.

- [021] Also, it is of course feasible to open the gate or the gate parts vertically and/or to use weight mechanisms.
- [022] Furthermore, it is feasible to let the apparatus according to the invention include a lock device, which locks the gate in its closing position but which unlocks it in an initial phase of the opening movement, e.g. by including a lock plunger in said hydraulic circuit.
- [023] In Fig 1 a pressure generating unit is shown, which normally is disposed at each side of a gate U on and/or in the ground. This unit comprises a stationary exterior box M having spider legs N, which provide increased stability, because they are fastened to the ground by means of holding-down bolts or the like. Inside the upwardly open exterior box an inverted, vertically movable interior box P is telescopically disposed, compression springs O extending between the bottoms of the two boxes. Also, one or several hydraulic compression cylinders A extend between the bottoms of the two boxes, which cylinders contain an anti-freezing liquid, e.g. water or glycol, which without problems functions between -30°C and $+60^{\circ}\text{C}$. Said hydraulic cylinders can be fastened to the bottom of the stationary box, whereas their pistons can be pressed against the interior side of the bottom of the movable box, thresholds S being provided on the upper side of the bottom of the movable box, which detect and establish the driving position of a car. Ramp plates Q, which are flexibly fastened to e.g. the upper/interior box close to its bottom, can constitute a guide to said upper side.
- [024] The hydraulic circuit will now be explained, reference being made to Fig 4. When eg the right front wheel of a car runs over a pressure generating unit, a pressure against cylinders A is exerted due to the weight of the car against the action of restoring springs O, which pressure is sufficient to press a hydraulic liquid through e.g. maintenance-free plastic pipes partly to an accumulator tank C, which accumulates some of the force as an overpressure, and partly to a secondary opening cylinder D, which by its piston stem T opens gate U against the action of the force of a closing spring V. The overpressure in the liquid is immediately released through a tube to an expansion tank B. The dis-charge takes place through a check valve G and is so slow, that it produces an effect only after the passage of the car and the start of the reduction of the overpressure in the expansion tank. A check valve H, mounted in the duct to opening cylinder D, provides a gentle opening

of the gate and guarantees, that the pressure liquid excess flows to accumulator tank C.

- [025]** Possible pressure peaks from very heavy cars and a second and a third axle respectively of the car are released directly through a overpressure valve I back to the expansion tank. However, since this valve only is opened at 10 bars, it does not obstruct the ordinary opening process and the ordinary slow closing but only handle possible overpressures, e.g. from several axles or heavy vehicles, which otherwise would break the system.
- [026]** The ordinary operative pressure in the system is 5-6 bars, which causes the gate to be fully opened against the force of closing spring V.
- [027]** Secondary opening cylinder D is mounted on a holder W, which in its turn is mounted on e.g. an existing fencing stake X in a pivoting way, which results in, that it during the opening and the closing process respectively by itself finds the correct angle in relation to a power arm Y. Cylinder D lies in a plane above holder W and power arm Y lies in its turn in a plane above cylinder D, which results in, that the opening cylinder is allowed to move freely in relation to holder W, whereas the power arm is allowed to move freely in relation to opening cylinder D. Power arm Y suitably is shaped like a boomerang in order to not collide with stake X. It extends around the stake, which also facilitates the mounting.
- [028]** Gate U is closed against the other existing stake Z with a contact surface or stop . When the gate has been opened and the car has left the pressure generating unit, springs O press back the interior box to its upper starting position. By that means a negative pressure is obtained in the primary pressure cylinder, which consequently draws back liquid from the expansion tank. In this way the primary cylinder is ready to start the entire cycle again. In the secondary cylinder the pressure is reduced, since liquid is released back to the expansion tank through a check valve G. In this way the closing spring starts functioning and closes the gate slowly, since liquid must be pressed out of the secondary opening cylinder and through the check valve back to the accumulator tank.
- [029]** In Fig 4 an aerator L is also shown in the duct branch to accumulator tank C, an aerator M in the duct branch to opening cylinder D, check valves E and F in two duct branches from the pressure side of pressure cylinder A, a manometer J, connected after sheet valve F in the branch, and an aerator K, connected to the same branch.

- [030]** The entire pressure generating unit preferably is enclosed. The enclosure can downwards comprise a reinforced plastic fabric, which allows it to be simply spread out instead of using a substantially more expensive injection molded box of a suitable age resistant plastic material, which of course also is a possibility. Upwards the pressure generating unit can be covered with a steel mat-reinforced rubber mat, which partly will seal against moisture and dirt and partly tolerate tens of thousands of car runs.
- [031]** The exterior rigid metallic box is provided with four spider legs, which have holes in their outermost corners. Long bolts are inserted through these holes and fastened to the primary rock or long screws, which are fastened in plugs or the like in softer ground.
- [032]** Since the force, when the non-rigid interior metallic box is run over by a car, partly comprises a straight downwardly directed component and partly a component in the direction of travel of the car and forwardly directed parallel to the ground, it is important to eliminate the last-mentioned distortion force, which primarily runs the risk of throwing off the non-rigid box.
- [033]** One way of solving this problem is the following: The non-rigid box is provided with a number of cylinder bearings, which solely allow a vertical movement in the interior of the rigid box. Alternatively, ball bearings can be chosen or simply Teflon-coated surfaces, which however may result in fouling and seizure problems, or expander rails. Thanks to the chosen solution the entire active force from the car is converted into a vertical direction, a maximal power yield being obtained designed to influence the hydraulic system.
- [034]** A particular advantage of the design, shown in Figs 5 and 6, is obtained, since the pressing downwards of the interior box, already when the access ramp, which has been movably inserted into the box, is hit by the car, is facilitated. The ramp is fastened in the pressure indicator unit in such a way, that the fastening of it against the non-rigid box remains at the same point, seen in the direction of travel of the car, whereas the end of the ramp moves a small distance backwards seen in the direction of travel of the car, since the non-rigid box is pressed downwards and the ramp will be positioned more parallel to the ground.
- [035]** The pressure generating unit is conveniently made as a first module, which through two plastic hoses partly transfers the operative pressure to the secondary opening cylinder and partly brings back hydraulic liquid from the expansion tank to

the primary compression cylinder, when negative pressure occurs in it, when the car has left the pressure generating unit and the interior box is pressed upwards by the restoring springs.

- [036]** The accumulator tank, the pressure meter, the check valves, the overpressure valve and ancillary connections and attachments are conveniently made as a second module, which can be placed in a box (not shown), which can be fastened to a gate stake or the like.
- [037]** The secondary opening cylinder with its holder, spring and power arm can finally form a third module, which preferably is mounted on an existing stake in order to handle an existing gate, substantial cost savings being attained.
- [038]** The modules can be assembled in a factory and finished, filled with e.g. glycol for application areas, where frost may occur. Otherwise water will be adequate. The modules are connected to each other and air is discharged through aeration nipples. Subsequently the pressure generating unit is installed in the ground and the entire apparatus is ready to be used.
- [039]** In the diagram shown in Fig 7, besides the symbols already described, symbol 2 represents three measuring/aeration (venting) points, 5 a manometer, 21 three check valves, 23 a pressure limiting valve and 25 a manual opening valve.
- [040]** This apparatus functions in the following fashion and arbitrary details can of course be used on the apparatus described above and shown in the other figures:
- [041]** 1. Closed Gate
- [042]** The piston stem in cylinder D is activated by the basic pressure in accumulator B plus the force of spring V. The piston stem in cylinder A is activated by the basic pressure in accumulator B. The gate is hydraulically locked through valve 25, which is a pilot-controlled check valve.
- [043]** 2. Manual Opening
- [044]** Valve 25 can be opened manually by means of a bar. Liquid flows, when the gate is opened, partly through check valve 21a to the negative side of cylinder D and partly due to an equalization of the differential area of accumulator B. (The difference area is the difference of the area due to the fact, that the piston stem occupies an area of the negative side). Subsequent to a manual opening the gate is closed automatically, since there is the same pressure on both sides of the piston in cylinder D, but it is the force of spring V and the area difference in cylinder D, which causes the closing. By a manual opening the force is charged, which is

needed for an automatic closing. Thus, the manual opening can be repeated an arbitrary number of times.

[045] 3. Automatic Opening

[046] When cylinder A is run over by a car, the pressure and the flow are forwarded through check valve 21a. The gate starts to open due to choking H_a . This effect is loaded into accumulator C. Simultaneously pressure and flow starts to decrease through choking H_b . It is to be noted, that H_a is much larger than H_b , why a complete opening of the gate has time to occur and will remain for a certain time, before the discharge will produce an effect. At the same time as the gate opens, cylinder D will have a negative position (the piston stem is withdrawn), the hydraulic medium on the positive side of the cylinder jointly with accumulator B filling cylinder A. pilot-valve 25 is then kept open by the pressure of the negative side.

[047] 4. Overload Protection

[048] Valve 23 opens at a pressure above 10 bars. Thus, a repeated load on cylinder A, before the operative cycle has been concluded, results in, that the excess pressure and liquid will be emptied through valve 23. Compared to the construction shown and described above an automatic hydraulic locking of the gate is now obtained. Instead of (or possibly in addition to) a spring the hydraulic pressure, which is generated in the ramp, is used. In addition to that, a single hydraulic duct between the gate and the ramp is sufficient.

[049] The present invention is not limited to the embodiments described above and shown in the enclosed drawings, but it can be modified and supplemented in an arbitrary way within the scope of the inventive idea and the following claims. Thus, the apparatus can, as has already been mentioned, be used in connection with a pivotally suspended revolving gate, or a gate, which slides in rails in a straight or bent path. Instead of gates containers can also be contemplated, the contents of which will be emptied on e.g. a truck platform. By utilizing the driving and the weight of a car it is advantageous to use the described and shown apparatus in order to carry out an opening, closing, loading, discharging or the like movement, which otherwise only can be carried out in an engine-driven or manual way.